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JANUARY–FEBRUARY 1936

LAKE STATES FOREST EXPERIMENT STATION*

Forest Service U. S. Dept. Agr.

THE HURON BRANCH STATION

To solve some of the chief forest management problems peculiar to the Lower Michigan sand plains, of which the Huron National Forest is typical, the Lake States Forest Experiment Station to date has established on that forest 64 permanent sample plots covering some 490 acres.

Forest planting has been one of the major activities on the Huron National Forest since 1911. Therefore, it is only logical that research in this locality is concerned largely with forestation problems. For the study of forest planting, four blocks of 100 acres have been set aside, each on a distinctly different planting site. Each block has been sub-divided into ten plots, of ten acres each, one of which is planted annually or a total of 40 acres per year. Four species of pine (Norway, white, jack and Scotch) and four classes of stock are planted at different spacings, in various degrees and intimacies of mixture, with different techniques of planting. Regular examinations are made, at which time, kind and degree of cover affecting the plant, cause of loss or injury, besides survival are recorded. On each block there is a station for measuring physical factors--soil and air temperatures, precipitation and soil moisture--to aid in interpreting the results of planting. Results to date have shown considerable variability in sucess between the four sites chiefly due to differences in the amount and distribution of precipitation. The general superiority of transplant stock under severe conditions has also become evident.

* Maintained in cooperation with the University of Minnesota at University Farm, St. Paul, Minnesota.

An important and frequently disregarded basis for successful planting is proper seed source. On a plot of approximately 20 acres there has been planted Norway pine from more than 150 different seed collections made throughout the Lake States, the Northeast and Canada; and about 30 collections of Scotch pine, some from trees grown in this country of known form but uncertain primary origin, and some from several foreign sources ranging from Norway to Mongolia.

Other studies cover: the period of natural seed dispersal of Norway and jack pine; the effects of release and cultivation upon the growth and survival of planted trees; and the practicability and value of direct seeding of oak and black locust in intermixture with planted Norway pine.

In view of the growing importance of jack pine pulpwood operations on the Huron National Forest and the common lack of natural regeneration of the stand after cutting, an experiment covering 50 acres has been established to determine what methods of cutting, ground treatment and slash disposal are necessary to obtain natural reproduction.*

DIESEL OIL ELIMINATES SPROUTS

Recent tests** by the California Forest and Range Experiment Station have shown that Diesel oil may be used to kill stump sprouts. The oil, known on the market as Diesel Oil, 27° A.P.I. gr., was found to be fully as effective as sodium arsenite and to have none of the poison hazard of the latter. The oil is applied in a series of light hacks made in the stump at, and below the ground level. The oil is sprayed on the stump with a portable outfit utilizing a hand pressure pump.

In California, the method has been used chiefly to keep fire-breaks free of vegetation and has been found satisfactory for this purpose.

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* This is the fifth of a series of short articles describing the branch stations. Two more will appear in future issues.
** "Instructions in the Use of Diesel Oil in Killing Sprouting Stumps on California Firebreaks."by John R. Curry and H. D. Bruce, California Forest & Range Experiment Station.

GROUP SELECTION VERSUS SINGLE-TREE SELECTION

Group selection cutting in northern hardwoods in which small patches were clear cut has been found to result in less growth and greater mortality than single-tree selection. The results of the five year remeasurement of the group selection cutting at the Upper Peninsula Experimental Forest, shows the short-comings of the method.

The following table presents comparable figures of growth and mortality for the group selection and a single-tree selection of the same degree.

COMPARATIVE GROWTH

Method	Residual volume bd. ft.	Average Annual Growth			
		On old trees bd. ft.	On new trees *3* bd. ft.	Mortality bd. ft.	Net growth bd. ft.
Group Selection *1*	10,815	170.0	7.5	71.4	106.1
Single-Tree Selection *2*	7,550	176.2	16.8	30.4	162.6

1 45% cut.

2 46% cut.

3 Volume added by trees growing into the merchantable class. (9.5"+)

In the group selection cutting small patches from one fifth to one half acre in size were clear cut with the removal of good as well as poor trees and the surrounding area left practically intact. Between the clear-cut patches the cutting was so light that little stimulus in growth resulted. In addition, numerous overmature and defective trees were left which succumbed during the 5-year period thus increasing mortality. On the other hand, the single-tree selection permitted the removal of most of the poor trees and the leaving of a well spaced and thrifty residual stand. Although this area supported a smaller

residual volume than the group selection, its actual growth in board feet was greater and the mortality much less.

These results are only preliminary and it may be that in a stand which has been under careful management for many years. Group selection cutting might be useful in increasing the proportion of certain of the more intolerant species such as yellow birch and elm. But until such time as the majority of over- mature and defective trees can be eliminated, group selection is less silviculturally desirable than single-tree selection.

WHITE SPRUCE NEVER ABUNDANT IN MINNESOTA FORESTS

White spruce is one of the most valuable species in the Lake States and attempts are being made to grow it in large, pure stands. At the present time, white spruce occurs almost entirely as isolated individuals or small groups and is only infrequently seen in the form of stands occupying any considerable area. But the usual interpretation of this distribution is that these are the remnants of former extensive stands.

That the distribution of this species in the original forest was also irregular is well illustrated by timber estimates made in 1909 covering 704 forties located in St. Louis, Koochiching, and Lake of the Woods counties, Minnesota. The data, furnished through the courtesy of William Heritage of the U. S. Indian Service, are presented in the accompanying table.

Average Stand per acre Bd. Ft.	Percentage of total number of forties
125 - 500	34.1
500 - 1000	33.0
1000 - 1500	18.6
1500 - 2000	9.4
2000 - 2500	3.2
2500 - 3000	1.3
3000 - 3500	0.4
	100.0

Although some of these forties contained small areas of swamp and areas of light sandy soils which would tend to cut down the possible stand of white spruce, the estimates in the main are believed to present a fairly reliable picture of the occurrence of this species in the original forests of northern Minnesota. Only 14 per cent of the forties included in the estimate supported stands greater than 1500 board feet per acre and none over 3500 feet per acre.

It is readily apparent, therefore, that the original forests of Minnesota contained but a relatively small amount of white spruce, and thus the natural habits of the species indicate that perhaps it is not adapted to being grown in large, pure stands.

ARSENICAL TOXICITY OF NURSERY SOILS

Several planting beds in the Lydick Nursery at Cass Lake, Minnesota were treated with arsenate of lead in the spring of 1934 as a means of preventing white grub injury to young coniferous seedlings. Norway pine (1-0) grown in this soil showed severe browning of the leaf tips typical of arsenical injury. In an attempt to counteract the effect of the free arsenic in the soil, Shirley and Meuli conducted tests* in which sodium sulphide and sodium hyposulphite were used as neutralizing agents. These chemicals were applied to 24 suitable plots in concentrations sufficiently great to neutralize exactly the arsenic, twice that amount, and four times that amount. Eight similar control plots were set aside for comparison purposes.

Counts of healthy and injured seedlings were made before treatment, one month after treatment, and ten months after treatment. Statistical analysis of the data indicates that the single application of sodium hyposulphite did counteract the soil toxicity to such a degree that seedling survival was maintained.

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*These treatments were suggested by Dr. R. A. Gortner, Division of Biochemistry, University of Minnesota.

	Percent of Healthy Seedlings			
	Sept. 1934	July 1935	Loss of Healthy Seedlings	Standard Error %
	%	%	%	+ or -
No treatment	64.6	45.3	19.3	3.02
Sodium hypo-sulphite to neutralize	65.2	62.5	2.7	2.18

Other treatments gave only slightly better survival than the controls

Due, probably, to natural leaching of the arsenic, the general improvement of the Norway pine in nearby nursery beds was very marked in 1935 and this method is offered as an expedient in the event that similar cases of over-application of arsenic might occur.

AERIAL PHOTOGRAPHY IN FORESTRY

The Canadians* have recently made great advances in the use of aerial photographs for timber cruising, particularly in spruce forests. Methods have been developed for determining the height of the trees directly from the photographs, and studies correlating the height with volume have indicated a relationship which gives satisfactory estimates. Crown diameter has also been used as a factor in estimating volume.

Winter photographs have been found to give more information than those taken in the growing season because of the contrast between the dark conifers and the snow, and the absence of leaves on the hardwoods.

Experiments are now being conducted to develop a method of rendering tone values so that spruce and jack pine can be distinguished plainly in the photographs. This involves the use of the newer types of panchromatic or infra red film and filters.

* "The Use of Air Photographs for Forestry Purposes." by H. E. Seely, Forestry Chronicle Vol. XI, No. 4, December, 1935.

ACTUAL AND "NORMAL" GROWTH

Foresters who are used to thinking in terms of "normal" yields in making working plans for forest lands in the Lake States will doubtless be surprised at the low yields and low average growth of actual stands of native timber measured in the Lake States Forest Survey. The volume of even the fairly "well-stocked" areas was found to be but a fraction of the so-called normal for the same age.

The following table compares the actual volumes found in Minnesota with the normal for four of the most common types:

Comparison of Mean Annual Growth
in "Normal" and Actual Stands in Minnesota

Type	Approx. Site Index*	Assumed Rotation	Mean Annual Growth Bd. Ft. Scrib. Normal (Theoretical)	Better Stands** (Actual)	Av. of all Stands (Actual)
White Pine	55	100	435	100	55
Norway Pine	52	100	400	104	92
Jack Pine	58	60	183	141	110
Aspen	63	60	213	82	53

* Height of dominant trees at fifty years of age.
** Includes the most productive 10-15% of all stands.

The wide spread between actual and normal yields is partly a matter of lack of suitable management and to that extent is subject to improvement.

It is even more a matter of difference in utilization standards and to that extent it may be necessary for foresters to lower their sights in anticipating future growth even under good management. Specifically, normal yield tables deal with gross volumes and include trees as small as 6 and 7 inches in the sawtimber estimate. No allowance is made for rot, sweep, crook and other defects. In actual stands there is always a considerable amount of cull, ranging up to 40 or 50 percent in some species. Furthermore, even the best operators do not cut many trees less than 9 inches in diameter for sawlogs,

hence a much lower yield in actual stands. When dealing with large areas of forest, it is always necessary to allow a certain amount for natural openings in the forest - rocks, small marshes, streams and other permanent bare spots. All in all, actual yields of truly merchantable timber for large areas cannot be expected to approach even remotely the volumes shown in normal yield tables.

A set of empirical yield tables based upon "average" and "well-stocked" stands encountered on the Minnesota Forest Survey has been prepared by the Station and will be sent upon request.

BARK INJURY BY FEEDING RODENTS

Since there are in the Lake States several animals which regularly or occasionally feed on the bark of saplings or trees it is often necessary to know which of these animals is responsible for the damage. Usually damage caused by bark gnawing can be traced to one of the following rodents: porcupines, red, and gray squirrels, rabbits or mice. Each of these makes a different mark with his teeth and, according to C. M. Aldous of the Biological Survey, it is ordinarily relatively easy to distinguish between them.

Porcupines are the most frequent offenders. Although they confine their work largely to conifers, they somtimes feed on birch, aspen, and to a lesser extent cherry. Porcupines in this region seldom eat from the base of the tree, most of their feeding being confined to the upper half. As a rule, the marks left by their teeth on the bark extend obliquely to the main axis of the stem or branch. The width of the cut made by the incisors is approximately .07 to .09 inches (see Figure 1).

Red, and gray squirrels eat the bark of red, and sugar maples, and occasionally some of the conifers. They usually feed on these species during the late winter or early spring when the sap is flowing. On the maples the red squirrels generally gnaw in an oblique direction but often the teeth marks will be found to run in all directions. The width of the teeth marks of the red squirrel (see Figure 2) is exceedingly narrow, about .02 inches, while the marks left by the gray squirrel are slightly wider.

Snowshoe rabbits feed mostly by cutting off small twigs or whole plants but occasionally resort to barking small trees.

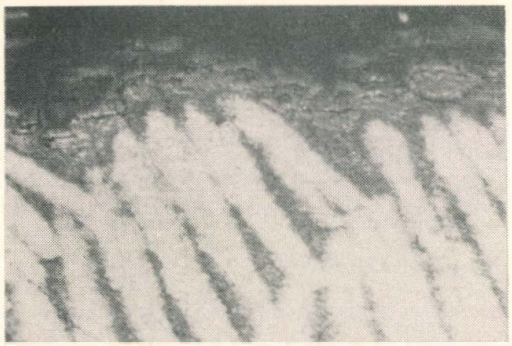

Fig. 1 Porcupine(Enlarged)

Fig. 2 Red Squirrel(Enlarged)

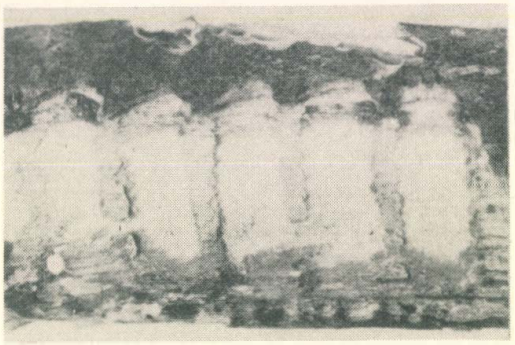

Fig. 3 Rabbit (Enlarged)

Their work is necessarily limited to the base of the tree, the damaged portion seldom exceeding a height of two feet above the ground. As a rule the teeth marks are made in a horizontal direction and across the stem. They are broad and individually distinct (see Figure 3). The width of the mark is slightly less than one eighth of an inch.

Mice also attack the bark of trees but their gnawing is almost wholly confined to the portion just beneath the duff near the ground line. The damage can seldom be seen unless the duff or top soil is scraped away.

SHELTERBELT REPORT OUT

"The Possibilities of Shelterbelt Planting in the Plains Region" which embodies the results of the investigations carried on by the Lake States Forest Experiment Station, has been published in a limited edition. It is 200 pages in length and is illustrated with many maps, drawings, and photographs. Reprints of some of the chapters will soon be available for a wider distribution.

GENERALIZED SOIL MAPS OF THE ENTIRE UNITED STATES

The Soils Section of the "Atlas of American Agriculture" has recently been issued by the Bureau of Chemistry and Soils. Two previous Sections of the "Atlas" have dealt with the distribution of the natural vegetation and with the various climatic factors throughout the United States. This latest Section is the result of many years of intensive soils study and survey. It presents a generalized soils map of the whole country in which the soils are classified according to the "great soil groups", such as Podzol soils, red and yellow soils, etc. Another map of the United States shows the soils classified according to their process of accumulation, such as Glacial Accumulations, Lake Deposits, Limestones, etc. In addition to these, twelve regional maps are given showing the soils classified according to the soil series system developed by the Bureau of Chemistry and Soils.

The regional map for the Lake States, while necessarily somewhat generalized, should be of considerable value in correlating forests and soils and in management planning.

Copies of this Atlas may be obtained from the Superintendent of Documents at a cost of $5.00 each.

STORAGE OF SEED AFTER ACID TREATMENTS

Nurserymen have asked if it is necessary to sow seeds immediately after treating them with sulphuric acid to overcome seed-coat dormancy or whether this treatment can be given at any convenient time and the seeds stored until the ground is ready for planting.

In order to answer this question, a series of experiments was begun in May, 1935. Samples of seeds of several species were treated with concentrated sulphuric acid, after which they were thoroughly washed and dried and one series immediately placed in the germination room. The remaining samples were stored dry at 10°C. (51°F.) for germination tests at the end of one, two, and five months. For comparison, additional samples were handled similarly except that acid treatment was not used.

The results of these tests are presented in the tabulation below:

EFFECT OF STORAGE ON SEED GERMINATION AFTER ACID TREATMENT

Species	Treatment	Storage Period			
		No Storage	One Month	Two Months	Five Months
		Germination Percent			
Honey Locust	None	5	3	2	15
Honey Locust	Acid-1 hr.	100	94	100	100
Honey Locust (thornless)	None	1	0	23	1
Honey Locust (thornless)	Acid-1 hr.	100	96	98	100
Ky. Coffee Tree	None	6	3	10	-
Ky. Coffee Tree	Acid-4 hrs.	90	78	68	61
Sumac	None	2	2	3	4
Sumac	Acid-20 min.	41	32	22	38
Soapberry	None	2	14	10	5
Soapberry	Acid-30 min.	21	23	31	19
Russian Olive	None	12	24	34	1
Russian Olive	Acid-2 hrs. Washed+2 hrs. acid	32	8	2	0
Black Locust	None	41	25	16	27
Black Locust	Acid-1 hr.	53	32	8	14

The seeds of honey locust, honey locust (thornless), sumac, and soapberry, can apparently be stored dry for five months at 51° F., after acid treatment, without any significant change in germination. Kentucky coffee tree seeds show a gradual decrease in germination of the acid treated seeds.

The seed of Russian olive and black locust, according to these experiments, cannot be stored after treatment and should be sowed immediately. A 2-4 hour scarification of the seed of black locust in a rotary type scarifier (see Forest Research Digest for December) is recommended instead of the acid treatment.

The results of these tests show that some seeds may be stored without lessening germination, but it is recommended that only in special cases should seeds be stored after acid treatment more than a week or two before sowing.

THE SMALL FOREST NURSERY IN EUROPE

By

H. L. Shirley*

Small forest nurseries, ranging in size from one-tenth acre up to two acres, are very common in many European forests. These nurseries are usually located on or near the planting site and vary in the intensity of culture and in method of treatment, depending on the desires and standards of the local forester. Often there may be two or more such small nurseries on a single ranger district of 5,000 acres or less.

These nurseries are temporary affairs, and are not equipped with water systems. They are usually located on small areas cleared for the purpose and fenced against game. The usual location is in a small opening in the forest or at the edge of a recent cutting where the seed beds will have some shade during a part of the day.

The nurseries are the direct responsibility of the ranger or forest laborers. In general, they are well cared for and the stock produced is thrifty and sturdy. The beds are kept weeded during the growing season, but no watering or fertilizing is ordinarily done.

The success of these small nurseries is probably due in a large part to the care taken in picking a site. The loamy soils, much heavier than those usually selected for forest nurseries in this country, are ordinarily chosen. If the area

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* During the past summer Dr. Shirley of the Experiment Station staff spent four months in Europe as a guest of the Oberlaender Trust, studying forestry conditions and methods, and this article is the first of a series describing some of the more interesting European methods.

has recently been in forest, its soil will still possess many of the characteristics of a true forest soil, thus rendering it quite satisfactory for seedling production.

An important advantage of the small nursery is that the limited quantities of seed required can usually be collected locally thus eliminating the possibility of introducing an inferior or ill-adapted race.

No information on the cost of stock from such nurseries was obtained, but since the nursery is only incidental to many other tasks performed by the ranger or forest worker responsible for it, the cost must be quite nominal. The largest costs, of course, are incurred in clearing and fencing. Such nurseries have many advantages over the larger ones, in that they allow greater flexibility in the planting work and may be established at comparatively small cost to the forest owner.

The writer has seen all of the species commonly used in forest planting in Europe grown in small nurseries. A substantial proportion of all planting stock is produced in these nurseries.

A description of the large nurseries will be given in the next issue of the "Digest".

TREE SEED MANUAL IN PREPARATION

The greatly expanded forest activities made possible by emergency conservation appropriations, have called into use a great number of trees and shrubs formerly neglected by nurserymen and other growers. The handling of these present many perplexing problems, some of which have been investigated on a small scale and others remain still unsolved. It was felt highly desirable to collect in one place the existing information on trees and shrubs of North America. This, the Lake States Forest Experiment Station, in cooperation with Henry I. Baldwin of the New Hampshire Forestry Department, has undertaken to do.

The manual will include an introduction of about 100 pages covering general information on reproduction by seed; on morphology, chemical composition, periodicity of seed crops, origin, collection time and technique, storage and longevity, biotic enemies of tree seeds and protection against same, seed disinfection, chemistry of germination, methods of testing germination, direct and indirect methods for testing viability, seed stimulation and methods of sowing.

Detailed information will be given for 500 - 600 species which fall into the following classes:

1. All tree species producing timber and other merchantable products.

2. All exotic timber trees which have been grown successfully in forest plantations, windbreaks or for other forestry purposes.

3. Shrubs valuable for erosion control and shelterbelt planting.

4. Shrubs useful for game food or game cover which are important enough and rare enough to justify artificial propagation.

Each Forest Experiment Station has submitted lists of species classified into the above groups and the Station is now engaged in compiling information on these.

NOTICE

During 1936, the "Forest Research Digest" will be published every two months instead of monthly.